

**Syllabus  
For The Trade of**

# **FITTER**

**Under**

**Craftsmen Training Scheme (CTS)  
&  
Apprenticeship Training Scheme (ATS)**

**Revised in – 2007**

**Government of India  
Ministry of Labour & Employment (DGE&T)  
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE  
EN Block, sector – V, Salt Lake,  
Kolkata – 700 091**

**List of Members present in the Trade Committee Meeting for revising the syllabus of Fitter under CTS / ATS**

<b>Sl. No.</b>	<b>Name and Designation</b>	<b>Organization</b>	
1	Shri M. S.Lingaiah, Director	CSTARI , Kolkata	Chairman
2.	Shri Ramesh.G.Naidu, Asst. Manager	Tata Motors, Pune	Member
3.	Shri B.K.Mondal, Manager	Tata Steel, SNTI, Jamshedpur	Member
4.	Shri T.S.Ramanathan, Dy. Manager	CESC Ltd. Kolkata	Member
5.	Dr. Dipankar Bose, Asst. Professor	TTTI, Kolkata	Member
6.	Shri Dilip Kr. Dubey, Asst. Director	DIT, West Bengal	Member
7.	Shri Titas Nandi, HOD Trg.	CTTC, Kolkata	Member
8.	Shri Sukumar Bose, Workshop Instructor	George Telegraph, Kolkata	Member
9.	Shri T.Mukhopadhyay, Dy.Director	CSTARI, Kolkata	Member
10.	Shri S.Kumar, Dy Director	CSTARI, Kolkata	Member
11	Shri A.Chakrabarti. Asst. Director	CSTARI, Kolkata	Member
12.	Shri V.Babu	CSTARI, Kolkata	Member

## GENERAL INFORMATION

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|--|---|
| 1. Name of the Trade :                   | FITTER  |
| 2. N. C. O. code No :                    | 842.10, 842.15  |
| 3. Entry Qualification :                 | Passed class 10 <sup>th</sup> Exam. Under<br>10+2 system of education or its<br>Equivalent.                               |
| 4. Duration of Craftsman Training :      | Two years.  |
| 5. Duration of Apprenticeship Training : | 3 years including Basic Training of two years   |
| 6. Rebate to Ex-ITI Trainees :           | a) 2 years for Ex-ITI Fitter<br>b) 1 year for Ex-ITI Millwright Maint. Mech.<br>c) 2 years for Ex-ITI Tool and Die Maker. |
| 7. Ratio of Apprentices to Workers :     | 1 : 5   |

### NOTE FOR APPRENTICESHIP TRAINING

1. The Practical Training Programme of Apprentices under ATS (Apprenticeship Training Scheme) should be as per the facilities available in the Establishment / Industry.
2. At the end of shop floor training, an apprentice shall appear for a final examination to be conducted at establishment level based on the actual shop floor training received by the apprentices. This examination shall comprise of assessment of work diaries maintained by the apprentices and Viva Voice to be conducted by an external examiner (other than an official directly responsible for shop floor training).

## SYLLABUS FOR THE TRADE OF FITTER UNDER CRAFTSMAN TRAINING SCHEME

Period of Training: 2 Years

Week No.	Practical	Theory	Engineering Drawing	Workshop Science and Calculation
1.	Familiarisation with the Institute, Importance of trade training, Machinery used in the trade, types of work done by the trainees in the trade. Introduction to safety equipments and their uses. Introduction of first aid, Road safety, operation of Electrical mains.	Importance of safety and general precautions observed in the Institute and in the section. Importance of the trade in the development of Industrial economy of the country. What are the related instructions, subjects to be taught, achievement to be made, recreational, medical facilities and other extra curricular activities of the Institute. (All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Introduction of First aid. Road safety. Operation of electrical mains. Introduction of safety kits.		
2.	Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions, sawing different types of metals of different sections.	Safety, accident prevention, linear measurements- its units, dividers, calipers, hermaphrodite, centre punch, dot punch, their description and uses of different types of hammers. Description, use and care of 'V' Blocks, marking-off table.	Engineering Drawing-- introduction to Engg. Drawing,, its importance.	Introduction to Property and uses of C.I. and wrought Iron.
3.	Filing Channel, Parallel. Filing- Flat and square (Rough finish).	Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws.	Types of lines their meaning & application as per BIS 696	Arithmetic: Fundamental operations,- addition , subtraction, multiplication, division of decimal number

4.	Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule, marking practice with dividers, odd leg calipers and steel rule (circles, arcs, parallel lines).	Files- specifications, description, materials, grades, cuts, file elements, uses. Measuring standards (English, Metric Units), angular measurements, subdivisions, try square, ordinary depth gauge, protractor- description, uses and cares.	Simple conventional symbols for material and parts as per BIS ---696	Properties and uses of plain carbon steel and alloy steel.
5.	Marking off straight lines and arcs using scribing block and dividers, chipping flat surfaces along a marked line.	Marking off and lay out tools, dividers, scribing block, odd leg calipers, punches- description, classification, material, care & maintenance.	Use of drawing instruments in the construction of Geometrical drawings- angles, triangles.	Fraction and decimal - conversion fraction decimal and vice-versa.
6.	Marking, filing, filing square, use of tri-square.	Calipers- types, material, constructional details, uses, care & maintenance of cold chisels- materials, types, cutting angles.	Geometrical construction of rectangles, square, circles.	Properties and uses of copper, zinc, lead, tin, aluminum.
7. & 8	Marking according to simple blue prints for locating, position of holes, scribing lines on chalked surfaces with marking tools, finding center of round bar with the help of 'V' block and marking block. Joining straight line to an arc.	Marking media, marking blue, Prussian blue, red lead, chalk and their special application, description. Use, care and maintenance of scribing block.	Geometrical construction of polygon and ellipse, parabola & hyperbola.	Composition, properties and uses of brass, bronze, solder, bearing material, timber, rubber etc.
9.	Chipping, Chip slots & oils grooves (Straight).	Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types and uses, workshop surface plate- their uses, accuracy, care and maintenance.	Geometrical construction of involute, oval, and helix.	System of units, British, metric and SI units for length, area, volume capacity, weight, time, angle, their conversions.
10.	Filing flat, square, and parallel to an accuracy of 0.5mm. Chip curve along a line-mark out, key ways at various angles & cut	Types of files- convexing, taper, needle, care and maintenance of files, various types of keys, allowable clearances & tapers, types, use of flex rollers	-----do-----	Effect of alloying elements in the properties of C.I. & steel.

11.	<p>key ways.</p> <p>File thin metal to an accuracy of 0.5 mm. Chip &amp; chamfer, grooving and slotting</p>	<p>uses of key pullers.</p> <p>Physical properties of engineering metal: colour, weight, structure, and conductivity, magnetic, fusibility, specific gravity. Mechanical properties: ductility, malleability hardness, brittleness, toughness, tenacity, and elasticity.</p>	<p>Free hand sketching of straight lines, rectangles, circles, square, polygons, ellipse.</p>	<p>Unit of temperature for &amp; related problems. Standard &amp; absolute temp.</p>
12.	<p>Saw along a straight line, curved line, on different sections of metal. Straight saw on thick section, M.S. angle and pipes.</p>	<p>Drilling processes: common type (bench type, pillar type, radial type), gang and multiple drilling machine.</p>	<p>Free hand sketching of simple geometrical solids, cube, cone, prism, cylinder, sphere, pyramids.</p>	<p>Mass, volume, density, sp. Gravity &amp; specific weight S.I. M.K.S. and F.P.S. units of force, weight etc. their conversion to related problems.</p>
13	<p>File steps and finish with smooth file accuracy <math>\pm</math> 0.25 mm. File and saw on M.S. Square and pipe welds</p> <p><b>Industrial visit to Mechanical Industry / manufacturing industry.</b></p> <p><b>ACHIEVEMENT: --</b></p>	<p>Micrometer- outside and inside – principle, constructional features, parts graduation, leading, use and care. Micrometer depth gauge, parts, graduation, leading, use and care. Digital micrometer.</p> <p><b>Industrial Visit</b></p> <p>The trainee should be able to</p> <ol style="list-style-type: none"> <li>1) Use fitters hand tools.</li> <li>2) Do simple marking out according to simple Blue print.</li> <li>3) Do filing / hack sawing and chipping.</li> </ol>	<p>Standard printing style for letters and numbers as per IS : 696.</p> <p><b>Industrial Visit</b></p>	<p>Mass, volume, density, weight, S.I. , M.K.S. and F.P.S. units of force weight etc. their conversion to related problems.</p> <p><b>Industrial visit.</b></p>
14.	<p>File radius along a marked line (Convex &amp;</p>	<p>Vernier calipers, principle, construction, graduations,</p>	<p>Free hand practice of</p>	<p>Inertia, rest and motion, velocity</p>

	concave) & match. Chip sheet metal (shearing). Chip step and file.	reading, use and care. Vernier bevel protractor, construction, graduations, reading, use and care, dial Vernier Caliper, Digital vernier caliper.	printing style for standard letters & numbers.	and acceleration.
15.	Punch letter and number (letter punch and number punch), use of different punches.	Drill holding devices-material, construction and their uses.	Scales-construction plan, . Representing fraction	Concept of scalar and vector quantity with examples, Newton's Law of motion.
16	<b>Revision &amp; Test</b> (Two days) Prepare forge. Fire for heating metals. Forge a square rod from round stock. Judge the forging temperature of various metals.	<b>Revision &amp; Test</b> Safety precautions to be observed in a smith shop, forge - necessity, description uses, fuel used for heating, bellows blowers, description and uses.	<b>Revision &amp; Test</b> Construction of diagonal scale.	<b>Revision &amp; Test</b> Power and roots Factor, Power base exponents number.
17.	Forge M.S. bar to square, octagon and hexagon.	Anvil and swage blocks. Description and uses. Forging tools-hammers-band and sledge, description and uses. Chisels, set hammers, flatters, hardier, fuller swage & uses.	Simple dimensioning technique, size and location, dimensions of parts, holes angles, taper, screw etc. as per BIS. 696.	Multiplication and division of power and root of a number.
18.	Forge flat chisel, grind and heat treatment of chisels.	Measuring and checking tools- steel rule, brass rule, calipers, try square, description and uses. General idea about the main operations performed in a forging shop such as upsetting drawing, twisting, bending, punching, drilling, and welding.	Transferring measurements for linear, angular, circular dimensions form the given object to the related free hand sketches using different measuring instruments.	Square root of number and problems
19.	Forge – punches, screw drivers, chisels, grind them to shape and heat treat to requirement, bending metals to angles,	Heat treatment, various heat treatment methods - normalizing, annealing, hardening and tempering. Power hammer –	Pictorial drawings, isometric drawings of simple	Work energy and power, their units and applied problems.

	curves & twisting, Preparation of brackets.	construction, features, method of operating and uses.	geometrical solids.	
20.	Marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips. Marking out of simple development, marking out for flaps for soldering and sweating.	Safety precautions to be observed in a sheet metal workshop, sheet and sizes, Commercial sizes and various types of metal sheets, coated sheets and their uses as per BIS specifications.	----do----	----do----
21.	Make various joints: wiring, hemming, soldering and brazing, form locked, grooved and knocked up single hem straight and curved edges form double hemming. Punch holes-using hollow and solid punches. Do lap and butt joints.	Marking and measuring tools, wing compass, Prick punch, tin man's square tools, snips, types and uses. Tin man's hammers and mallets type-sheet metal tools, stakes-bench types, parts, their uses. Soldering iron, types, specifications, uses. Trammel- description, parts, uses. Hand grooves- specifications and uses.	Oblique projection of simple geometrical solids.	Percentage, changing percentage to decimal and fraction and vice versa. Applied problems.
22.	Bend sheet metal into various curvature form, wired edges- straight and curves, fold sheet metal at angle using stakes. Bend sheet metal to various curvatures. Make simple Square, container with wired edge and fix handle.	Solders-composition of various types of solders, and their heating media of soldering iron, fluxes types, selection and application- joints wiring- various types of metal joints, their selection and application, tolerance for various joints, their selection & application.	Oblique projection of simple geometrical solids.	Problem on percentage related to trade.
23.	Make square tray with square soldered corner Make funnel as per development and solder joints Make riveted lap and butt joint.	Rivets-Tin man's rivets, types, sizes, selection for various works. Riveting tools, dolly snaps, description and uses. Method of riveting, shearing machine- description, parts and uses.	Isometric drawing of simple machined & casting blocks.	Different types of loads, stress, strain, modulus of elasticity.
24.	Welding - Striking and maintaining arc, laying	Safety-importance of safety and general precautions	----do---	Ultimate

	straight-line bead.	observed in a welding shop. Precautions in electric and gas welding. (Before, during, after) Introduction to safety equipment and their uses.		strength, different types of stress, factor of safety, examples.
25.	Making square, butt joint and 'T' fillet joint-gas and arc. Do setting up of flames, fusion runs with and without filler rod, gas and arc.	Hand tools: Hammers, welding description, types and uses, Machines and accessories, welding transformer, welding generators, description, principle, method of operating, carbon dioxide welding.	----do----	----do---
26.	Make butt weld and corner, fillet welding- Gas and Arc. Practice in soft soldering and silver soldering.	H.P. welding equipment: description, principle, method of operating L.P. welding equipment: description, principle, method of operating. Types of Joints-Butt and fillet as per BIS specifications.	Free hand sketches of trade related hand tools and measuring tools.	Ratio & proportion- Ratio, finding forms ratio proportions, direct proportion and indirect proportion.
27.	Gas cutting.	Oxygen acetylene cutting-machine description, parts, uses, method of handling, cutting torch-description, parts, function and uses. Gases and gas cylinder description, kinds, main difference and uses.	----do---	Application of ratio and proportion & related problems.
	<b>INDUSTRIAL VISIT</b> (Fabrication Industry)	<b>INDUSTRIAL VISIT</b>	<b>INDUSTRIAL VISIT</b>	<b>INDUSTRIAL VISIT</b>

**ACHIEVEMENT:**

The trainee should be able to do :-

1. Simple joining, drawing and bending.
2. Simple heat-treating operations like hardening, tempering and annealing.
3. simple square container, round container with wired edge and fit handle.
4. Rivet lap and butt joint.
5. Butt and fillet welds-gas and arc.
6. Gas cutting.

Sl.No.	Practical	Theory	Engineering Drawing	Workshop Science and Calculation
28.	True job on four jaw chuck using knife tool, face both the ends for holding between centres, Using roughing tool parallel turn $\pm 0.1$ mm. Measure the diameter using outside caliper and steel rule.	Safely precautions to be observed while working on a lathe, Lathe specifications, and constructional features. Lathe main parts descriptions- bed, head stock, carriage, tail stock, feeding and thread cutting mechanisms. Holding of job between centers, works with catch plate, dog, simple description of a facing and roughing tool and their applications.	Simple sketches of trade related hand tools & measuring instruments	Simple machines-principle, velocity ratio, mechanical advantage, efficiency, related problems.
29.	Lathe operations- the facing, parting and form tools, plain turn, step turn, holding job in three jaw chuck- deburr, chamfer-corner, round, the ends, Shoulder turn : square, filleted, beveled under cut shoulder, turning-filleted under cut, square beveled.	Lathe cutting tools- Brief study of the nomenclature of Lathe cutting tools and necessity of correct grinding, solid and tipped, throw away type tools, cutting speed and feed and comparison for H.S.S., carbide tools. Use of coolants and lubricants.	Machines- basic principles, velocity, ratio, mechanical advantage, and efficient, simple problems.	Simple machines-principle, velocity ratio, mechanical advantage, efficiency. Simple problems.
30.	Cut grooves- square, round 'V' groove, Make a mandrel-turn diameter to sizes. Knurl the job.	Chucks and chucking the independent four-jaw chuck. Reversible features of jaws, the back plate, Method of clearing the thread of the chuck-mounting and dismounting, chucks, chucking true, face plate, drilling - method of holding drills in the tail stock, Boring tools and enlargement of holes.	Orthographic drawings, application of both the first angle and third angle. Method of representing the drawings for simple and complex machine parts, exercises with dimensions.	Algebraic symbols, fundamental algebra operations, sign and symbols used in algebra, coefficient terms, and unlike terms.

31.	Bore holes –spot face, pilot drill, enlarge hole, using boring tools, make a bush step bore-cut recess, turn hole diameter to sizes.	General turning operations- parallel or straight, turning. Stepped turning, grooving, shape of tools for the above operations. Appropriate method of holding the tool on tool post or tool rest, Knurling: - tools description, grade, uses, speed and feed, coolant for knurling, speed, feed calculation.	----do----	Algebraic addition, subtraction, multiplication and division.
32.	Turn taper ( internal and external ). Turn taper pins .Turn standard tapers to suit with gauge.	Taper – definition, use and method of expressing tapers. Standard tapers-taper, calculations morse taper.	Orthographic drawings application of both the first angle and third angle. Method of representing the drawings for simple and complex machine blocks given for exercises with dimensions.	Power and exponent. Laws of exponent.
33..	Threading practice by using cut threads using taps, dies on lathe by hand, 'V' thread – external. Prepare a nut and match with the bolt.	Screw thread definition – uses and application. Terminology of screw threads, square, worm, buttress, acme ( non standard-screw threads ),Principle of cutting screw thread in centre lathe – principle of chasing the screw thread – use of centre gauge, setting tool for cutting internal and external threads, use of screw pitch gauge for checking the screw thread.	-----do-----	Algebraic simplification problems.

**ACHIEVEMENT:** - The trainee should be able to do:

1. Chucking, centering, plain turning, taper turning, boring and thread cutting.
2. Precision marking, fit contours and geometrical figures and make male and female parts.

34.	Mark off and drill through holes, drill on M.S. flat, file radius and profile to suit gauge.	Drill- material, types, (Taper shank, straight shank) parts and sizes. Drill angle-cutting angle for different materials, cutting speed feed. R.P.M. for different materials.	Standard method of sectioning as per B IS: 696. Exercises for different sectional views on the given orthographic drawing of machine part, castings etc	Simple machines like winch pulley and compounding axle etc.
35.	Step fit, angular fit, file and make angle, surfaces (Bevel gauge accuracy 1 degree) make simple open and sliding fits.	Drill troubles: causes and remedy. Equality of lips, correct clearance, dead centre, length of lips. Drill kinds : Fraction, metric, letters and numbers, grinding of drill.	----do----	Factors and equations : Algebraic formula.
36.	Enlarge hole and increase internal dia. File cylindrical surfaces. Make open fitting of curved profiles.	Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing. Bench grinder parts and use-radius gauge, fillet gauge, material, construction, parts function and metric, different dimensions, convex and concave uses care and maintenance.	----Do----	Factors and different types of factorisation.
37.	Make the circles by binding previously drilled hole. Test angular match up.	Radius gauge, feeler gauge, hole gauge, and their uses.	Standard method of sectioning as per BIS.696 Exercises for different sectional views on the given orthographic drawing of machine parts, casting etc	Equations simple simultaneous equation

**ACHIEVEMENT:** - The trainee should be able to do:

1. Chucking, centering, plain turning, taper turning, boring and thread cutting
2. Position marking, fit contours and geometrical figures and make male and female parts.

38.	Inside square fit, make combined open and sliding fit, straight sides 'T' fit.	Vernier height gauge : material construction, parts, graduations (English & Metric) uses, care and maintenance, Pig Iron : manufacturing process ( by using)Blast furnace types, of pig Iron , properties and uses.	Conversion of isometric, oblique drawings to orthographic drawings and vice-versa. Related problems such as 'V' block oriented by	Equation simple simultaneous, quadratic.
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39.	File fit- combined, open angular and sliding sides. File internal angles 30 minutes accuracy open, angular fit.	Cast Iron: manufacturing process by using (cupola furnace) types, properties and uses. Wrought iron- : manufacturing process (Fuddling and Astor process ) properties and uses.	various machining operations etc. -----do-----	Application, construction and solution of problems by equation.
40.	Make sliding fit with angles other than 90°, sliding fit with an angle.	Steel: manufacturing process plain carbon steels, types, properties and uses.	-----do---	Atmospheric pressure, pressure gauge, gauge pressure and absolute pressure and their units.
41.	Make simple bracket by bending and twisting of non-ferrous metal. Drill small holes (2mm) Drill holes on sheet metal, bend short for round bracket.	Non-ferrous metals (copper, aluminum, tin, lead, zinc, ) properties and uses.	-----do---	Logarithms and use of logarithms tables:
42.	Form internal threads with taps to standard size (through holes and blind holes) – Drill through hole and tap drill blind hole and tap, prepare studs and bolt.	Screw threads: terminology, parts, types and their uses. Screw pitch gauge: material parts and uses. Taps British standard (B.S.W., B.S.F., B.A. & B.S.P.) and metric /BIS (course and fine) material, parts (shank body, flute, cutting edge). Method of using and use of calculating tap hole sizes. Tap wrench: material, parts, types (solid & adjustable types) and their uses removal of broken tap, studs (tap stud extractor).	-----do----	Logarithms: logarithm and exponent. Use of logarithms and anti-logarithm table.
43.	Form external threads with dies to standard size. Prepare nuts and match with bolts.	Dies : British standard, metric and BIS standard, material, parts, types, Method of using dies. Die stock: material, parts and uses.	-----do-----	Arithmetical operations involving logarithms in the computations.
44.	Counter sink, counter bore	Counter sink, counter bore and	-----do-----	Problem related

	and ream split fit (three piece fitting).	spot facing-tools and nomenclature, Reamer-material, types (Hand and machine reamer), kinds, parts and their uses, determining hole size (or reaming), Reaming procedure.		to the trade using logarithm tables.
45.	Filling & scraping of bearing to close precision.	Scrapers and their types, methods of scraping.	Surface development of simple geometrical solids like cube, rectangular block, cone, pyramid, cylinder, prism etc.	----do----
46.	File and fit combined radius and angular surface (accuracy $\pm 0.5$ mm), angular and radius fit. Locate accurate holes. Make accurate hole for stud fit.	Vernier micrometer, material, parts, graduation, use, care and maintenance.	----do---	Specific gravity, principle of Archimedes.
47.	Make assembly for dovetail sliding fits using lower pins and screws ( $\pm 0.04$ mm)	Screw thread micrometer: Construction, graduation and use.	----do---	Relation between specific gravity and density simple experimental determination.
48.	Cutting threads using dies. Make sliding fits assembly with parallel and angular mating surface. ( $\pm 0.04$ mm)	Dial test indicator, construction, parts, material, graduation, Method of use, Care and maintenance. Digital dial indicator. Comparators-measurement of quality in the cylinder bores.	Interpretation of solids and conventional application of intersectional curves on drawing.	<b>Geometry:</b> Fundamental geometrical definition-angles and properties of angles, triangles, and properties of triangles.
49.	Practice on testing of machine tools and general shop maintenance.	Preventive maintenance-objective and function of P.M., section inspection. Visual and detailed, lubrication survey, system of symbol and colour coding.	---do---	Pythagoras theorem, properties of similar triangles.

50 & 51.	Simple repair work, simple assembly of machine parts from blue prints.	Revision, simple estimation of materials, use of handbooks and reference table.	Solution of NCVT test paper (preliminary) Revision.	Revision.
52.	Test.	Test.	Test (Preliminary)	Test

**ACHIEVEMENT:** The Trainee should be able to do:

1. Drill holes, counter bore and spot face.
2. Sharpen drill-bits.
3. Use height and depth gauge, micrometer and vernir calipers to an accuracy of 1/1000/100 mm.
4. Markup, punching, cutting, chipping, and file jobs as per blue prints and able to finish an accuracy of 0.003"/0.08 mm.
5. Operate a bench drill and to drill ream holes.
6. Use of taps and dies.

53.	Prepare triangle, hexagon on ends of a cylinder bar, prepare female end and fit.	Keys and keyways. Types and their uses, construction (shape).	Revision of first year topics.	Revision of 1 <sup>st</sup> year course.
54.	Make key and keyways on the shaft and fit. "V" grooves and slots on the cast iron block.	Spring-material types and uses.	---do---	----do---
55.	Make riveted joints (lap and butt joints)	Bolts and Nuts: Material, types (Hexagonal and square head) and their uses.	Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS.	Rectangle, square, Rhombus, parallelogram and their properties.
56.	Drill on cylindrical surface.	Washers: Material, types (spring, tab, plain washer and fiber washer).	----do---	Circle and properties circle: regular polygons.
57.	Scrap on flat surfaces, scrap on curved surfaces and scrap surface parallels and test. Make & assemble, sliding flats, plain surfaces.	Simple scraper- cir., flat, half round, triangular and hook scraper and their uses.	Sketches for bolts, nuts, screws and other screwed members.	Application of geometrical to shop problems.

58.	Make simple dowel pins, fitting dowel pins and tap screw assembly.	Dowel pins : material, construction, types, accuracy and uses.	Sketches for bolts, nuts, screws and other screwed members.	Heat & temperature, thermometric scales, their conversions.
59.	Assembly sliding for using keys and dowel pin and screw, $\pm 0.02$ mm accuracy on plain surface.	Screws: material, different types (inch & metric), uses.	Standard rivet forms as per BIS.	Temperature measuring instruments.
60.	Testing of sliding fitting job, scrap on two flat surfaces and curved surfaces.	Testing scraped surfaces: ordinary surfaces without a master plate.	--do--	Specific heats of solids & liquids., quantity of heat.
61.	File & fit angular mating surface plain within an accuracy of $\pm 0.02$ mm & angular 15 minutes angular fitting.	Special files: types (pillar, Dread naught, Barrow, warding) description.	Riveted joint.	Heat loss and heat gain, with simple problems.
62.	Drill through and blind holes at an angle-drill blind holes, 'Y' fitting.	System of drill size, Fractional size: number, letter and metric. Templates and gauges- Introduction, necessity, types.	Riveted joints-but.	Mensuration: Plain figures-triangles, square, rectangle, parallelogram.
63.	Dovetailed fitting, radius fitting.	Gauges: Introduction, necessity, types-description and uses of gauge- types (feeler, screw, pitch, radius, wire gauge) ,description and use.	Sketches of keys, cotter and pin joints.	Plain figures. Trapezium, regular polygons, circle, hollow circles.
64.	Precision drilling, reaming and tapping. Test- Job.	Limit gauge: Ring gauge, snap gauge, plug gauge, description and uses.	----do---	Plain figures- segment and sector of circle, ellipse, fillets.

**ACHIEVEMENT: The Trainee should be able to do:**

1. Make key and key ways on the shaft and fit.
2. Make riveted joints.
3. Scrap on flat and curved surfaces.
4. File to an accuracy of  $\pm 0.05$  mm and  $\pm 10$  minutes on angle filling & sliding assembly.

65.	File and fit, combined fit with straight, angular surface with $\pm 0.02$ mm accuracy, hexagonal fitting.	Slip gauge: Necessity of using, classification & accuracy, set of blocks (English and Metric). Details of slip gauge. Metric sets 46: 103: 112. Wrining and	Sketches for simple pipe, unions with simple pipe line drawings.	Solid figures: Prism, cylinder, pyramid, cone.
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		building up of slip gauge and care and maintenance. Application of slip gauges for measuring, Sine bar-Principle, application & specification.		
66.	Drilling and reaming, small dia. holes to accuracy correct location for fitting Make male and female fitting parts, drill and ream holes not less than 12.7 mm.	Locking device: Nuts- types (lock nut castle nut, slotted nuts, swam nut, grooved nut) Description and use.	---do---	Solid figures: frustum of a cone, sphere, spherical segment.
67.	Sliding fitting, Diamond fitting, Lapping flat surfaces using lapping plate.	Lapping: Application of lapping, material for lapping tools, lapping abrasives, charging of lapping tool. Surface finish importance, equipment for testing-terms relation to surface finish. Equipment for tasting surfaces quality – dimensional tolerances of surface finish.	Concept of preparation of assembly drawing and detailing. Simple assemblies & their details of trade related tools/job/exercises with the dimensions from the given sample or models. Tool post for the lathe with washer and screw.	Material weight and cost problems related to trade.
68.	Stepped keyed fitting-test job. Lapping holes and cylindrical surfaces.	Honing: Application of honing, material for honing, tools shapes, grades, honing abrasives. Frosting- its aim and the methods of performance.	---do---	Trigonometry: trigonometrical ratios, use of trigonometrical table.
69.	Making a snap gauge for checking a dia of $10 \pm 0.02$ mm.	Interchangeability: Necessity in Engg, field definition, BIS. Definition, types of limit, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone.	Details and assembly of Vee-blocks with clamps.	Area of triangle by trigonometry.
70.	Scrape angular mating surface, scrap on internal surface.	Different standard systems of fits and limits. British standard system, BIS system., Method of expressing tolerance as per BIS	Details and assembly of Vee-blocks with clamps.	Finding height and distance by trigonometry.
71.	Practice in dovetail fitting assembly and dowel pins and cap screws assembly.  Industrial visit.	Fits : Definition, types description of each with sketch.  Industrial visit.	Details of assembly of shaft and pulley.  Industrial visit.	Application of trigonometry in shop problems.  Industrial visit.

72.	Preparation of gap gauges.	Manufacture: The name and types of gauge commonly used in gauging finished product-Method of selective assembly 'Go' system of gauges, hole plug basis of standardisation.	Details of assembly of shaft and pulley.	Application of trigonometry in shop problems
73.	Dovetail and Dowel pin assembly, scraps cylindrical bore.	Bearing-Introduction, classification (Journal and Thrust),Description of each, ball bearing: Single row, double row, description of each, and advantages of double row.	Details of assembly of bush bearing.	Triangle of forces, parallelogram of forces.
74.	Scrapping cylindrical bore and to make a fit-make a cotter jib assembly.	Roller and needle bearings: Types of roller bearing. Description & use of each. Method of fitting ball and roller bearings.	Details of assembly bush bearing.	Composition and resolution of forces.
75.	Scrapping cylindrical taper bore, check taper angle with sine bar, check in per angle (flat) with sine bar.	Bearing metals – types, composition and uses, lubricants purpose of using different types, description and uses of each type.	Details of assembly of a simple coupling.	Representation of forces by vectors- simple problems on lifting tackles like jib cranes, wall cranes etc.
76.	Preparation of centre, squares, drills gauges.	Synthetic materials for bearing: The plastic laminate materials, their properties and uses in bearings such as phonolic, peylon polymide (nylon).	---do---	---do---

**ACHIEVEMENT:** The Trainee should be able to do :-

1. File to an accuracy of  $\pm 0.04$  mm on flat surfaces and on angular surfaces  $\pm 5$  minutes.
2. Drill and ream to  $\pm 0.04$  mm.
3. Fit dowel pin, studs, bolts and dovetailed sides etc.
4. Use of sine bar and slip gauges, inspect angles to  $\pm 1$  minute.
5. Remetal, scrap and assemble bearings.

77.	File and fit straight and angular surfaces internally.	Hardening and tempering, purpose of each method, tempering colour chart.	Details and assembly of a simple hand vice.	Moments of force, couples.
78.	Heat treatment of tools.	Annealing and normalising, purpose of each method.	---do---	Simple problems on straight and bell cranked lever.
79.	Flaring of pipes and pipe joints, heat	Case hardening and carburising and its methods, process of	Details and assembly of	Centre of gravity, simple experimental

	treatment of cold chisels.	carburising (solid, liquid and gas).	simple hand – vice.	determination, stable, unstable & neutral equilibrium, simple explanation
80.	'H' fitting-exercises on lapping of gauges (hand lapping only)	Solder and soldering.: Introduction-types of solder and flux. Method of soldering , Hard solder- Introduction , types and method of brazing.	---do---	---do---
81.	Hand reams and fit taper pin, drilling and reaming holes in correct location, fitting dowel pins, stud, and bolts.	Production of gauges, templates and jigs. The objective of importance for preparing interchangeable components.	---do---	Friction- co-efficient of friction.
82.	Simple jigs and fixtures for drilling.	Drilling jig-constructural features, types and uses.	Blue print Reading. Simple exercises related to missing lines.	Simple problem related to friction.
83.	Prepare a 'V' block and a clamp.	Fixtures-Constructural features, types and uses.	---do---	Magnetic substances- natural and artificial magnets.
84	Marking out as per Blue print, drilling, straight and curve filing. Threading with die, cutting slot, and cutting internal threads with taps, making an adjustable spanner.	Revision.	---do---	Method of magnetisation. Use of magnets.
85.	Cutting & Threading of pipe length. Fitting of pipes as per sketch. Conditions used for pipe work to be followed. Bending of pipes- cold and hot.	Pipes and pipe fitting- commonly used pipes. Pipe bending methods. Use of bending fixture, pipe threads-Std. Pipe threads Die and Tap, pipe vices.	---do---	Electricity & its uses electric current- positive & negative terminals.
86.	Practice-dismantling & assembling – globe valves sluice valves, stop cocks, seat valves and non-return valve, fitting of pipes and testing for leakage.	Standard pipefitting-. Methods of fitting or replacing the above fitting, repairs and erection on rainwater drainage pipes and house hold taps and pipe work. Use of tools such as pipe cutters, pipe wrenches, pipe dies, and tap, pipe bending machine etc.	Simple-exercises relating missing symbols.	Use of fuses and switches, conductors and insulators.
87.	Practice in handling Fire extinguishers of different types ,refilling of	Fire precautions-causes and types of fires, precautions against out break of fire. Fire Extinguishers- types and use.	Simple exercises relating to missing symbols.	Simple electric circuits ,simple calculations.

	extinguishers.			
88.	Marking detail includes male & female screw cutting, male and female fitting parts. Making and tempering springs.	Working material with finished surface as aluminium, duralumin, stainless steel, the importance of keeping the work free from rust and corrosion. The various coatings used to protect metals, protection coat by heat and electrical deposit treatments. Treatments and provide a pleasing finish as chromium silver plating and nickel plating, and galvanising.	Simple exercises related to missing section.	Ohm's Law. Simple calculation, electrical insulating materials.

**ACHIEVEMENT:** The Trainee should be able to be:

1. Carry out simple plumbing assembly.
2. Make simple jigs and fixtures.
3. Mark male and female parts of regular contours including tongue and groove, dovetailed slide to and accuracy of  $\pm 0.04$  mm.

89.	Exercises on finished material as aluminium and stainless steel, marking out, cutting to size, drilling etc. without damage to surface of finished articles.	Aluminium and its alloys. Uses ,advantages and disadvantages, weight and strength as compared with steel.	Simple exercises related to missing section.	Graphs : abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.
90.	Making out for angular outlines, filing and fitting the inserts into gaps. Making a simple drilling jig, Marking out, filing to line, drilling and tapping brass and copper jobs.	Tapers on keys and cotters permissible by various standards. Discuss non-ferrous metals as brass, phosphor bronze, gunmetal, copper, aluminium etc. Their composition and purposes where and why used, advantages for specific purposes, surface wearing properties of bronze and brass.	Simple exercises related to missing dimensions.	----do---
91.	Complete exercises covering the assembly of parts working to detail and arrangement – Drawings. Dismantling and mounting of pulleys. Making replacing damaged keys. Repairing damaged gears and mounting. Repair & replacement of belts.	Power transmission elements. The object of belts, their sizes and specifications, materials of which the belts are made, selection of the type of belts with the consideration of weather, load and tension methods of joining leather belts.  Vee belts and their advantages and disadvantages, Use of commercial belts, dressing and resin creep and slipping , calculation.	---do---	Practice on simple pocket calculator.
92.	Complete exercises covering the assembly	Power transmissions, coupling types- flange coupling, -Hooks coupling-	Further practice on	Mechanical properties of

	of parts working to details and arrangements as per drawings. Dismantling and mounting of pulleys. Making, replacing damaged keys. Repairing damaged gears and mounting them on shafts.	universal coupling and their different uses.	logarithm.	metals.
93.	More difficult work in marking out including tangents, templates involving use of vernier protractor.	Pulleys-types-solid, split and 'V' belt pulleys, standard calculation for determining size crowning of faces-loose and fast pulleys-jockey pulley. Types of drives-open and cross belt drives. The geometrical explanation of the belt drivers at an angle.	----do---	----do---
94.	Fitting of dovetail slides.	Power transmission -by gears, most common form spur gear, set names of some essential parts of the set-The pitch circles, Diametral pitch, velocity ratio of a gear set, Helical gear, herring bone gears, bevel gearing, spiral bevel gearing, hypoid gearing, pinion and rack, worm gearing, velocity ration of worm gearing. Repair to gear teeth by building up and dovetail method.	Solution of NCVT test.	Basic Electronics.
95.	Male and female dovetail fitting repairs to geared teeth. Repair of broken gear tooth by stud. Repair broker gear teeth by dovetail.	Method or fixing geared wheels for various purpose drives. General cause of the wear and tear of the toothed wheels and their remedies, method.of fitting spiral gears, helical gears, bevel gears, worm and worm wheels in relation to required drive. Care and maintenance of gears.	Solution of NCVT test papers.	----do---
96.	Marking out on the round sections for geometrical shaped fittings. Finishing and fitting to size, checking up the faces for universality.	Lubrication and lubricants- Method of lubrication., A good lubricant, viscosity of the lubricant, Main property of lubricant. How a film of oil is formed in journal. Bearings, method of lubrication-gravity feed, force (pressure) feed, splash lubrication. Cutting lubricants and coolants: Soluble off soaps, suds-paraffin, soda water, common lubricating oils and their commercial names, selection of lubricants.	----do---	Transmission of power by belt, pulleys & gear drive.
97.	Shaping-parallel block	Chains, wire ropes and clutches for	Solution of	Calculation of

	& 'V' block.	power transmission. Their types and brief description.	NCVT test papers.	Transmission of power by belt pulley and gear drive.
98.	Drilling for riveting. Riveting with as many types of rivet as available, use of counter sunk head rivets, use of counter bore tool to fit cheese head bolts. Use of pop rivets and gun.	Discuss the various rivets shape and form of heads, riveting tools for drawing up the importance of correct head size. The spacing of rivets. Flash riveting, use of correct tools, compare hot and cold riveting.	Revision	----do----
99.	Hydraulics & pneumatic valves and circuits.	Installation, maintenance and overhaul of machinery and engineering equipment and Hydraulics & pneumatic symbols & exercise. Hydraulics pneumatic circuits.	Revision	Solution of NCVT test papers.
100.	Milling-plan, slot & angular cutting.	Clutch: Type, positive clutch (straight tooth type, angular tooth type) .	Revision	Basic Electronic control system.
101.	Grinding-surface & circular.	Washers-Types and calculation of washer sizes. The making of joints and fitting packing. The use of lifting appliances, extractor presses and their use. Practical method of obtaining mechanical advantage. The slings and handling of heavy machinery, special precautions in the removal and replacement of heavy parts.	Revision	----do---
102.	Simple repair of machinery, making of packing gaskets, use of hollow punches, extractor ,drifts, various types of hammers and spanners, etc. Practicing, making various knots, correct loading of slings, correct and safe removal of parts. Erect sample machines.	Foundation bolt: types (rag, Lewis cotter bolt) description of each erection tools, pulley block, crow bar, spirit level, Plumb bob, pipe 2 X 4', wire rope, manila rope, wooden block.	Revision	----do---
103.	Revision	Revision	Institute Test	Institute Test
104.	Test.	Test.	Test.	Test.

**ACHEVEMENT:** The Trainee should be able to :

1. Dismantle and assemble simple machine parts and accessories.
2. Repair broken gear tooth.
3. Make simple drilling jig.
4. Erect machine.

**LIST OF TOOLS AND EQUIPMENT FOR THE FIRST 52 WEEKS (1 YEAR)  
FOR A BATCH OF 16 TRAINEES.**

Sl. No.	Name of the Tools & Equipment	Quantity for Instructor	Quantity for Trainees.	Total
1.	Rule steel 15 cm with metric graduation	1	16	17
2.	Square try 10 cm blade.	1	16	17
3.	Caliper outside 15 cm spring	1	16	17
4.	Caliper inside 15 cm spring.	1	16	17
5.	Caliper 15 cm hermaphrodite	1	16	17
6.	Divider 15 cm spring	1	16	17
7.	Straight Scriber 15 cm.	1	16	17
8.	Punch centre 10 cm	1	16	17
9.	Screw driver 15 cm	1	16	17
10.	Chisel cold flat 10 cm	1	16	17
11.	Hammer ball peen 0.45 kg. With handle	1	16	17
12.	Hammer ball peen 0.22 kg. With handle.	1	16	17
13.	File flat 25 cm. second cut	1	16	17
14.	File flat 25 cm. smooth	1	16	17
15.	File half round second cut 15 cm.	1	16	17
16.	Hacksaw frame fixed 30 cm.	1	16	17
17.	Safety goggles.	1	16	17
18.	Dot slot punch 10 cm.	1	16	17
	<b>Tools - Instruments &amp; General Shop Outfit per Unit.</b>			
19.	Rule steel 30 cm to read metric.	4		
20.	Rule steel 60 cm.	4		
21.	Straight edge 45 cm steel	2		
22.	Flat surface 45 x 45 cm CI /Granite.	2		
23.	Marking table 91 x 91 x 122 cm.	1		
24.	Universal scribing block 22 cm.	2		
25.	V-Block pair 7 cm and 15 cm with clamps	2		
26.	Square adjustable 15 cm blade.	2		
27.	Angle plate 10 x 20 cm.	2		
28.	Level spirit 15 cm metal	1		
29.	Punch letter 3 mm set.	1		
30.	Punch number set 3 mm.	1		
31.	Punch hollow 6 mm to 19 set of 5	2		
32.	Punch round 3mm x 4 mm set of 2.	2		
33.	Portable hand drill (Electric) 0 to 6 mm	2		
34.	Drill twist s/s 1.5 to 12 mm by 0.5 mm	1 Set		
35.	Drill twist S/S 8 mm to 15 mm by ½ mm	1 Set		
36.	Taps and dies complete set in box B.A	1		
37.	Taps and dies complete set in box with-worth.	1		
38.	Taps and dies complete set in box 3-18 mm set of 10	1		
39.	Filed wording 15 cm smooth	4		

40.	File knife edge 15 cm smooth	4		
41.	File cant saw 15 cm smooth	4		
42.	File feather edge 15 cm smooth	4		
43.	File triangular 15 cm smooth	2		
44.	File round 20 cm second cut	8		
45.	File square 15 cm second cut	4		
46.	File square 25 cm second cut	4		
47.	Feeler gauge 10 blades	1 Set		
48.	File triangular 20 cm second cut.	8		
49.	File flat 30 cm second cut.	8		
50.	File flat 20 cm bastard	8		
51.	File flat 30 cm bastard.	8		
52.	File Swiss type needle set of 12.	2 Sets		
53.	File half round 25 cm second cut.	8		
54.	File half round 25 cm bastard.	4		
55.	File round 30 cm bastard.	4		
56.	File hand 15 cm second cut.	8		
57.	Card file.	8		
58.	Stone oil 15 cm x 5 cm x 2.5 cm	4		
59.	Stone carborandum 15 cm x 5 cm x 5 cm x 4 cm.	2		
60.	Can oil 0.25 liters.	2		
61.	Pliers combination 15 cm	2		
62.	Iron soldering 350 gm.	2		
63.	Lamp blow 0.55 liters.	2		
64.	Spanner whit-worth D.E. 6 -26 mm set of 10 pcs.	8		
65.	Spanner adjustable 15 cm	2		
66.	Interchangeable ratchet socket set with a 12 mm driver, sized 10-32 mm set of 18 socket & attachments.	1 Set		
67.	Box spanner set 6-25 mm set of 8 with Tommy bar.	1 Set		
68.	Glass magnifying 7 cm	2		
69.	Clamp toolmaker 5 cm and 7.5 cm set of 2.	2		
70.	Clamp "C" 5 cm	2		
71.	Clamp "C" 10 cm	2		
72.	Hand Reamer adjustable cover max 9 ,12,18mm – set of 3	1 Set		
73.	Hand Reamer taper 4 -9mm set of 6 OR 4 -7 mm set of 4.	1Set		
74.	Reamer parallel 12 - 16mm set of 5.	1		
75.	Scraper flat 15 cm.	8		
76.	Scraper 3 corner 15 cm	8		
77.	Scraper half round 15cm	8		
78.	Chisel cold 9 mm cross cut 9 mm diamond.	8 each		
79.	Chisel cold 19 mm flat	8		
80.	Chisel cold 9 mm round noze.	8		
81.	Extractor stud EZY – out	2		
82.	Set combination 30 cm.	2		
83.	Micrometer 0 – 2.5 cm outside.	3		
84.	Micrometer 25 – 50 mm outside.	3		
85.	Micrometer 0 – 25 mm outside.	4		
86.	Micrometer 50 –75 mm outside.	2		
87.	Micrometer inside 25 - 50 mm with 25 mm test pcs.	1		

88.	Vernier caliper 20 cm	1		
89.	Vernier height gauges 30 cm.	1		
90.	Vernier bevel protractor.	1		
91.	Screw pitch gauge.	1		
92.	Wire gauge, metric standard.	1		
93.	Drill twist T/S 6 mm to 25 mm x 1.5.	1 Set		
94.	Drill chuck 12 mm.	1		
95.	Pipe wrench 40 cm	1		
96.	Pipe wrench 30 cm	1		
97.	Pipe vice 100mm	2		
98.	Adjustable pipe tap set BSP with die set cover pipe size 15, 20, 25,32,38,50 mm.	1		
99.	Wheel dresser (One for 4 units).	1		
100.	Machine vice 10 cm.	1		
101.	Machine vice 15 cm	1		
102.	Sleeve drill Morse 0 – 1, 1 – 2, 2 – 3.	1 Set		
103.	Vice bench 12 cm jaws.	16		
104.	Vice leg 10 cm jaw.	2		
105.	Bench working 240 x 120 x 90 cm.	4		
106.	Almirah 180 x 90 x 45 cm.	2		
107.	Lockers with 6 drawers (standard size).	2		
108.	Metal rack 182 x 182 x 45 cm	1		
109.	Instructor Table	1		
110.	Instructor Chair	1		
111.	Black board with easel.	1		
112.	Fire extinguisher (For 4 Units)	2		
113.	Fire buckets.	2		
114.	Machines vice 100mm.	2		
115.	Wing compass 25.4 cm or 30 cm.	2		
116.	Hand hammer 1 kg. with handle.	2		
	<b><u>Tools for Allied Trade- Blacksmith &amp; Sheet Metal Work</u></b>			
121.	Hammer smith 2 kg. With handle.	2		
122.	Tongs roving 350mm.	2		
123.	Tongs flat 350mm.	2		
124.	Smith's square 45 cm x 30 cm.	1		
125.	Cold set rodded 25X200mm.	2		
126.	Hot set rodded 25X200mm.	1		
127.	Swages top & bottom 12 mm /19	1 Each		
128.	Swage block 35 x 35 x 12 cm.	1		
129.	Flatters (rodded) 55 mm square.	2		
130.	Fuller top & bottom 6 mm 9 mm (Pair).	2		
131.	Anvil 50 kg.	2		
132.	Anvil stand	2		
133.	Shovel.	2		
134.	Trammer 30cm.	1		
135.	Rake.	2		
136.	Quenching tank (To be made in the Institute).	1		
137.	Pocker.	2		

138.	Hardle.	2		
139.	Leather apron.	2		
140.	Prick punch.	2		
141.	Mallet.	2		
142.	Snips straight 25 cm.	2		
143.	Setting hammers with handle.	2		
144.	Planishing hammer.	2		
145.	Snip bent 25 cm.	2		
146.	Stake hatchet.	2		
147.	Stake grooving.	2		
148.	Gauge imperial sheet.	1		
<b><u>General Machinery Installation</u></b>				
1.	Drilling machine pillar sensitive 0-20 mm cap with swivel table motorised with chuck & key.	1		
2.	Drilling machine bench sensitive 0-12 mm cap motorised with chuck and key.	2		
3.	Forge portable hand blower 38 cm to 45 cm.	1		
4.	Grinding machine (General purpose) D.E. pedestal with 2 cm dia wheels rough and smooth with twist drill grinding – attachment.	1		
5.	* CNC Milling Trainer with all accessories and consumables in duplicate	1		
* If CNC m/c is available in workshop, then no need to purchase CNC Milling m/c.				
<b>Note: -</b>				
1. No additional items of the above list are required to be provided for a batch of 16 trainees working in the second shift except the item under “Trainees Tool kit and Lockers”.				
2. No additional number of items (*) marked are required to be provided up to four batches of trainees (i.e. two batches in the first shift and two in the second shift.				
3. Drilling machine (Bench Type one additional number is require to be provided for each additional batches i.e. in the 1 <sup>st</sup> and 2 <sup>nd</sup> shift.				

The specifications of the items in the above list have been given in Metric Units. The items which are available in the market nearest of the specification as mentioned above, if not available as prescribed should be procured Measuring instruments such as steel rule which are graduated both English and Metric Units may be procured, if available.

**MODIFIED LIST OF TOOLS FOR THE 2<sup>ND</sup> YEAR FOR FITTER TRADE.**

(Vide letter no DGET -21 (1) 88 - CD Dtd. 5.7.88)

SL.NO.	Name of the Tools & Equipment	Quantity
1.	Gauge slip as Johnson metric set.	1 Set
2.	Carbide Wear Block 1 mm - 2 mm.	2 each
3.	Gauge snap Go and Not Go 25 to 50 mm by 5mm. Set of 6 pcs.	1 Set
4.	Gauge plug single 3 ended 5 to 55 by 5 mm. Set of 11 pcs.	1 Set
5.	Gauge telescopic upto 150 mm.	1
6.	Dial test indicator .01 mm on stand	1
7.	Sine bar 125 mm.	1
8.	Sine bar 250 mm.	1
9.	Lathe tools H.S.S. tipped set.	2
10.	Lathe tools bit 6 mm x 75 mm.	12
11.	Lathe tools bit 7 mm x 75 mm.	12
12.	Lathe tools bit 9 mm x 85mm.	12
13.	Arm strong type tool bit holder R.H.	2
14.	Arm strong type tool bit holder L.H.	2
15.	Arm strong type tool bit holder straight.	2
16.	Stilson wrenches 25 cm	2
17.	Water pump plier 250 mm.	2
18.	Pipe cutter 6 mm to 50 mm wheel type.	1
19.	Pipe bender spool type up to 25 mm. with stand manually operated.	1
20.	Adjustable pipe chain tonge to take pipes up to 300 mm.	1
21.	Adjustable spanner 38 cm long.	1
22.	Dial vernier caliper 0 - 200 mm LCO 0.05 mm. (Universal type).	1
23.	Screw thread micrometer with interchangeable 0-25mm. Pitch anvils for checking metric threads 60.	1
25.	Depth micrometer 0-100 mm. 0.01 mm.	1
26.	Vernier caliper 0-130 mm. L.C. 0.02 mm.	1
27.	Comparators stand with dial indicator LC 0.01mm.	1
28.	Engineer's try square (knife-wedge) 150 mm blade.	1
29.	Surface roughness comparison plates N1 - N12 grade	1 Set

**General Machinery Installations: -**

1. Electric Furnace with capacity 600 °C to 1400 °C. 1 No
2. Lathe all geared head stock S.S. and S.C. height of centre over bed 15 cm - gap head complete with accessories e.g. pump, all fittings and splash guard driving plate with drives, face plate 3 jaw and 4 jaw chucks fixed and travelling steady compound turret tool post, taper turning attachment, fixed and running centres, driving dogs straight and bent tails. 2 Nos.

Note:- No additional number of items are required to be provided up to four batches of trainees i.e. two batches in the first shift and two in the second shift.

Only one number need be provided in each I.T.I. irrespecting No of Units.

**LIST OF ISI BOOKS FOR REFERENCE FOR FITTER TRADE.**

(For use of Instructors only)

SL.No.	Titles	Code
1.	Spring calipers.	IS : 4052 - 1967
2.	Punches	IS : 413 - 1974
3.	Matric steel scales for Engineers.	IS : 1481 - 1970
4.	Engineers square.	IS : 2013 - 1972
5.	V-Block.	IS : 2049 - 1974
6.	Steel straight edges.	IS : 2220 - 1962
7.	Hacksaw blades.	IS : 2504 - 1977
8.	Bench vices.	IS : 2586 - 1975
9.	Chisels (Cold)	IS : 402 - 1974
10.	Engineer's file.	IS : 1931 - 1972
11.	Surface plates (C.I.)	IS : 2285 - 1974
12.	Twist drill	IS : 5100 - 1960 to 5106
13.	Vernier depth gauges.	IS : 4213 - 1967
14.	External micrometers.	IS : 2967 - 1964
15.	A dimension for counter - sinks & counter bores.	IS : 3406 - 1975
16.	Internal micrometers.	IS : 2966 - 1964
17.	Vernier calipers.	IS : 3651 - 1974
18.	Vernier height gauges.	IS : 2021 - 1964
19.	Gib - head keys and key ways.	IS : 2203 - 1974
20.	Taper keys and key ways.	IS : 2292 - 1974
21.	Screw driver.	IS : 884 - 1972
22.	Bevel protractors.	IS : 4229 - 1970
23.	Reamers.	IS : 1836 - 1961
24.	Thread cutting dies.	IS : 1859 - 1961
25.	Metric screw threads (Metric thread pitch-gauges)	IS : 4211 - 1967
26.	Dial gauges.	IS : 2092 - 1962
27.	Hexagonal bolts and nuts.	IS : 2038 - 1968
28.	Feeler gauges (m.m. ranges).	IS : 3179 - 1976
29.	Spanners, open jaw.	IS : 2028 - 1968
30.	Thickness of sheet & diameters of wire	IS : 1137 - 1950
31.	Centre drills.	IS : 6703 - 1977
32.	Lathe, sizes for general purpose.	IS : 2392 - 1963
33.	Recommendations for tapping drill sizes.	IS : 3230 - 1970
34.	Needle files.	IS : 3152 - 1965
35.	Plain plug gauges.	IS : 6137 - 1871
36.	Plain ring gauges (Go)	IS : 3435 - 1972
37.	Snap gauges (Go & No Go)	IS : 3477 - 1973
38.	Slip gauges.	IS : 2984 - 1966
39.	Ball & roller Bearings gauging practice for.	IS : 4025 - 1967
40.	V-belt for Industrial purposes.	IS : 2404 - 1974
41.	Limits & fits for engineering, recommendations for	IS : 919 - 1963
42.	Plain limit gauges tolerances for.	IS : 3455 - 1971
43.	Rivets for general purposes.	IS : 2155 - 1961
44.	Tapers for general engineering purposes.	IS : 3458 - 1966
45.	General Engineering drawing.	IS : 696 -

**LIST OF ADDITIONAL TOOLS FOR ALLIED TRADE IN WELDING**

1.	Transformer welding set 300 amps. – continuous welding current, with all accessories and electrode holder	1 Set
2.	Welder cable to carry 400 amps. With flexible rubber cover	50 Meter
3.	Lungs for cable	12 Nos.
4.	Earth clamps.	2 Nos.
5.	Arc welding table (all metal top) 122 cm X 12 cm X 60 cm with positioner.	1 No.
6.	Oxy – acetylene gas welding set equipment with hoses, regulator and other accessories.	1 Set.
7.	Gas welding table with positioner	1 No
8.	Welding torch tips of different sizes	1 Set
9.	Gas lighter.	6 Nos
10.	Trolley for gas cylinders.	1 No
11.	Chipping hammer.	2 Nos
12.	Gloves (Leather)	2 Pairs
13.	Leather apron.	2 Nos
14.	Spindle key for cylinder valve.	2 Nos.
15.	Welding torches 5 to 10 nozzles.	1 Set.
16.	Welding goggles.	4 Pairs.
17.	Welding helmet with coloured glass	2 Nos.
18.	Tip cleaner	10 Sets.

**Note: -** Those additional items are to be provided for the Allied Trade Training where the welding trade does not exist.

**LIST OF ISI BOOKS FOR REFERENCE FOR FITTER TRADE.****(For use of Instructors only)**

<b>SL.No.</b>	<b>Titles</b>	<b>Code</b>
1.	Spring calipers.	IS : 4052 - 1967
2.	Punches	IS : 413 - 1974
3.	Metric steel scales for Engineers.	IS : 1481 - 1970
4.	Engineers square.	IS : 2013 - 1972
5.	V-Block.	IS : 2049 - 1974
6.	Steel straight edges.	IS : 2220 - 1962
7.	Hacksaw blades.	IS : 2504 - 1977
8.	Bench vices.	IS : 2586 - 1975
9.	Chisels (Cold)	IS : 402 - 1974
10.	Engineer's file.	IS : 1931 - 1972
11.	Surface plates (C.I.)	IS : 2285 - 1974
12.	Twist drill	IS : 5100 - 1960 to 5106
13.	Vernier depth gauges.	IS : 4213 - 1967
14.	External micrometers.	IS : 2967 - 1964
15.	A dimension for counter - sinks & counter bores.	IS : 3406 - 1975
16.	Internal micrometers.	IS : 2966 - 1964
17.	Vernier calipers.	IS : 3651 - 1974
18.	Vernier height gauges.	IS : 2021 - 1964
19.	Gib - head keys and key ways.	IS : 2203 - 1974
20.	Taper keys and key ways.	IS : 2292 - 1974
21.	Screw driver.	IS : 884 - 1972
22.	Bevel protractors.	IS : 4229 - 1970
23.	Reamers.	IS : 1836 - 1961
24.	Thread cutting dies.	IS : 1859 - 1961
25.	Metric screw threads (Metric thread pitch-gauges)	IS : 4211 - 1967
26.	Dial gauges.	IS : 2092 - 1962
27.	Hexagonal bolts and nuts.	IS : 2038 - 1968
28.	Feeler gauges (m.m. ranges).	IS : 3179 - 1976
29.	Spanners, open jaw.	IS : 2028 - 1968
30.	Thickness of sheet & diameters of wire	IS : 1137 - 1950
31.	Centre drills.	IS : 6703 - 1977
32.	Lathe, sizes for general purpose.	IS : 2392 - 1963
33.	Recommendations for tapping drill sizes.	IS : 3230 - 1970
34.	Needle files.	IS : 3152 - 1965
35.	Plain plug gauges.	IS : 6137 - 1871
36.	Plain ring gauges (Go)	IS : 3435 - 1972
37.	Snap gauges (Go & No Go)	IS : 3477 - 1973
38.	Slip gauges.	IS : 2984 - 1966
39.	Ball & roller Bearings gauging practice for.	IS : 4025 - 1967
40.	V-belt for Industrial purposes.	IS : 2404 - 1974
41.	Limits & fits for engineering, recommendations for	IS : 919 - 1963
42.	Plain limit gauges tolerances for.	IS : 3455 - 1971
43.	Rivets for general purposes.	IS : 2155 - 1961
44.	Tapers for general engineering purposes.	IS : 3458 - 1966
45.	General Engineering drawing.	IS : 696 -

**LIST OF ADDITIONAL TOOLS FOR ALLIED TRADE IN WELDING**

1.	Transformer welding set 300 amps. – continuous welding current, with all accessories and electrode holder	1 Set
2.	Welder cable to carry 400 amps. With flexible rubber cover	50 Meter
3.	Lungs for cable	12 Nos.
4.	Earth clamps.	2 Nos.
5.	Arc welding table (all metal top) 122 cm X 12 cm X 60 cm with positioner.	1 No.
6.	Oxy – acetylene gas welding set equipment with hoses, regulator and other accessories.	1 Set.
7.	Gas welding table with positioner	1 No
8.	Welding torch tips of different sizes	1 Set
9.	Gas lighter.	6 Nos
10.	Trolley for gas cylinders.	1 No
11.	Chipping hammer.	2 Nos
12.	Gloves (Leather)	2 Pairs
13.	Leather apron.	2 Nos.
14.	Spindle key for cylinder valve.	2 Nos.
15.	Welding torches 5 to 10 nozzles.	1 Set.
16.	Welding goggles.	4 Pairs.
17.	Welding helmet with coloured glass	2 Nos.
18.	Tip cleaner	10 Sets.

**Note:** - Those additional items are to be provided for the Allied Trade Training where the welding trade does not exist.

**SYLLABUS FOR THE TRADE OF FITTER UNDER APPRENTICESHIP TRAINING SCHEME**  
**FOR PERIOD OF THREE YEARS**

1<sup>st</sup> year :- During 1<sup>st</sup> year and 2<sup>nd</sup> year the apprentices will undergo the syllabus some as CTS.  
&

2<sup>nd</sup> year.

3<sup>rd</sup> year. :- In 3<sup>rd</sup> year course of Training the operations prescribed for 1<sup>st</sup> year and 2<sup>nd</sup> year course of Training should be repeated to brush up their skills. Actual training will depend on the existing facilities available in the establishments. The establishment / industries who falls in any one of categories listed below should engage the apprentice for the trade of Fitter :-

1. Establishment having the facilities like Fitter, work, bench, vice, Tools.
2. Establishment having the facilities like Marking, Tools, Measuring tools etc.
3. establishment having the facilities like Lathe machine, shaper machine, Drill Machine, Grinding machine, Welding machine.
4. Establishment having the facilities like Forging and heat Treatment equipments.
5. Establishment having the facilities like Cranes and hoists, Chain pulley, Screw jack and other lifting equipments.

**The list of the skills to be imparted in the shop floor training for the apprentices are listed below as a reference.:-**

1. Make square, Traingular and hexagonal files to an accuracy of + .02 mm and to ISI specification.
2. Marking according to given drawing and punching along with line.
3. File angles internal and external to an accuracy of 90 minutes.
4. File angles internal and external and check with radius gange.
5. File and file internal and external profiles.
6. Scrape angular matting and sliding surfaces and original flat surfaces without master.
7. Prepare keys and key ways an shaft and assemble.
8. drill through holes and blind holes at an angles.
9. Counter sink, counter bore and spot face.
10. Hand and machine reaming on finish drilled holes.
11. Ream tapers and fit pins.
12. Make small rectangular containers from shut metal.
13. Bend brackets from thin mild steel strips.
14. Bend steel pipes to different radius and angles.
15. Thread standard pipes, join pipes and make pipe assemble.
16. Repair and maintain ordinary fitters tools such chisel, Hammer, Screw driver, Scriber, Centre punches, dividers, trammel and scrapers.
17. Dismantle and minor repair and assemble simple machine tools such as drill machine , shaper, slotter, planner, lathe and power saw.
18. Erect and align machines.
19. Assemble finished mechanical component to from specific unit or machine such as grinder pump etc. Using hand tools and machines.
20. Dismantle or remove worn out broken or defective parts using hand tools and replace them by repaired or new one's test completed article to ensure correct performance.
21. Fit parts together in set order using nuts, bolts, screws and pins etc.with necessary wrenches, spanners and other special tools.

22. Mounting of Pulleys and Gears on shafts.
23. Mechanical handling of machines for transportation purposes involve the use of screw jacks, pulley blocks, cranes, hoists and slings, roller bars and wire ropes etc.
24. Remove and fit ball and roller bearings.
25. Repair a broken gear teeth by pigging and dovetailing.
26. Size metal parts to close tolerances and fits and assemble them using hand tools for production or repairs of mechanical device or other metal products.
27. Lap and finish flat surfaces.
28. Carry out forging and heat treatment operation required for reconditioning and repairing of chisel, punches, scribes and screw drivers.
29. Heat treat plain carbon steel.
30. Make spring and heat treat.
31. Anneal and bend copper pipes to different shapes.
32. Handle Jigs and Fixtures.
33. Make simple Limit Gauges and Templates.
34. Make oil grooves on bearing with chisel.
35. Solder and joint ferrous and non ferrous component (soft and hard ).
36. Weld a M.S. bracket.
37. Weld two plates of same thickness.
38. Weld two lengths of M.S. rod of same diameter.
39. Gas cut plates and sheets for the required dimensions.
40. Familiarization with pumps, air compressor, pneumatic tools and hydraulic driver machines
41. Basic CNC M/C programming using ISO Codes  
Basic knowledge about PLC, Electronic Control.
42. Revisions

### TRADE THEORY ( 3<sup>RD</sup> Year )

1. Safety at work. Accidents-their causes, General safety rules, Protective devices and guard, action taken in emergencies.
2. Revision of work of previous two years.
3. Brief description of Machine Tools used in Fitting Shop such as Lathe m/c- construction, types, functions
4. Common turning operation, cutting speed, feed and depth of cut, Lathe tools-their angles, care & maintenance.
5. Shaper m/c-types, parts, construction, quick return mechanism, speed, feed and depth of cut.
6. Grinding m/c-types, functions, safety observed while working on a grinding machine.
7. Common drilling, boring and reaming operation-its tools and materials, speed and feed.
8. Terms of Limit as per BIS 919, definition, types of limit, basic size actual size, deviation, high and low limit, system of limit, Hole and Shaft basis.
9. Fits-Definition, types, description of each with sketches.
10. Method of expressing Tolerance as per BIS, Tolerance, zeroes, clearance and Interference (Max, Min and mean).
11. Interchangeability-Definition and its necessity.
12. Heat treatment of metals-annealing, tempering, normalising and case hardening of mild steel components. Heat treatment of cutting tools.
13. Joining and fastening devices-permanent, semi-permanent, temporary fasteners of different types and their function,-nuts, bolts, rivets, studs, pins, cotters, keys, screws etc.

14. Toothed gear and gearing-types and uses of spur, helical, bevel, haring bone, spiral bevel gearing, rack and pinion, worm and worm wheel for various purposes drives, gear elements.
15. Chains and sprockets-description, types, uses and method of fixing.
16. Mechanical, Hydraulic and Pneumatic drives-Basic principles.
17. Prime movers-Line shaft driver system and self drive system, different drives-reciprocating, reverse, eccentric, crank, cam, rotary to linear and vice-versa.
18. System of speed variation using stepped pulleys, gear box, discontact-speed control (Electrically and Hydraulically ).
19. Bearing-necessity and classification, description, ball bearing-single row and double row-description and advantage, roller and needle bearing-type and description
20. Lubrication and Lubricants-necessity and types of lubricants-liquid, semi-liquid and solid. Properties of lubricants-viscosity, oiliness, sp.gravity, flash point, fire points, freezing point, qualities of good lubricants and importance of correct use of lubricants and their commercial names.
21. System of lubrication-gravity feed, force feed, splash method etc.
22. Inspection-Need of inspection, types, stage inspection, routine inspection, final inspection, types of instruments and equipments used for inspection.
23. Introduction to work simplification related to the trade-job study, job analysis, planning of sequence of operation.
24. Maintenance-Its importance in productivity, types, preventive maintenance.
25. Material Handling-different types of appliances and tackle for shifting, loading and unloading of machine and equipment.
26. Screw Jack-use and working principle.
27. Chain Pulley Blocks-use and working principle.
28. Cranes and Hoists for lifting purposes-working principle and main constructional features.
29. Working principles and use of other tackles like crab and wrenches, slings,rollers, bars and levers.
30. Special precautions in the handling of heavy equipments, removal and replacement of heavy parts.
31. Quality and finish of work-surface finish-necessity, degree of surface finish,surface finish symbol and its numerical value, method of surface finish processes such as lapping, honning, buffing.
32. Protection of finished surface-like Picking, Oxidising, Electroplating, Galvanising, Metal spraying, metalisation and anodizing.
33. CNC M/C-ISO Codes, standard G Codes, N Codes.
34. Basic Electronic Control.
35. Revision

### WORKSHOP SCIENCE & CALCULATION ( 3 rd. YEAR )

NOTE : The Syllabus in the subject of Workshop Calculation & Science for the first two years under ATS would be identical to that of 2 years under CTS and would remain unchanged.

#### ( A ) Workshop Science

1. Revision of the previous years syllabus with some practical problems related to trade.
2. Problems on mensuration,work,power and energy.
3. Difference between pressure and force, velocity & speed, acceleration & retardation.
4. Mechanical properties- Tenacity, Elasticity, Malleability, Brittleness, Hardness, Compressibility and Ductility.
5. Sress, Strain, Modulus of Elasticity, Ultimate Tensile Strength, Factor of Safety and different types of stress.

6. Friction – Limiting friction, Laws of friction, co-efficient of friction and angle of friction on inclined plane. Simple problems on sliding friction & rolling friction.
7. Examples on uniformly loaded beams
- 8 Brief description of the manufacturing process of steel, copper, aluminium, cast iron and pig iron.
9. Expansion of solid, liquid and gases due to heat, co-efficient of different expansion.
10. Description of transfer of heat-conduction, convection and radiation .
11. Solution of NCVT Test papers
12. Revision.

### **( B ) Workshop Calculation**

1. Revision of previous years syllabus with practical problems related to trade.
2. Surface speed of Drilling, Turning.
3. Calculation of machining time for drilling, turning, milling, shaping and grinding.
4. Feed, depth of cut and volume of metal removed in turning, drilling, milling and shaping.
5. Simple gear calculation-gear ratio, calculation of spur gear, transmission of power by belt.
6. Solution of NCVT test papers.
7. Revision.

### **ENGINEERING DRAWING ( 3 rd YEAR )**

NOTE : The Syllabus or the course outlines in the subject of Engineering Drawing for the first two years training under ATS ,training programme would be identical to the training of 2 years under CTS and remain unchanged.

1. Review and revise the first two years course contents related to the trade.
2. Sketches of orthographic / isometric / oblique views with dimension, section and symbols for the given object / parts / components, e.g. machined blocks involving with various operations, a machined block for bearing, housing bracket, angle plate V-block, single point cutting tool e.t.c.
3. Sketches of the joints of screwed members, locking devices for screw threads, shaft couplings using bolts, nuts, keys, cotter joint between shaft and sleeves.
4. Standard welding symbols as per BIS and their applications on drawing of a welded fabrication.
5. Systems of the application of limits and fits. Geometrical tolerance, machine symbols, geometrical tolerance on drawing. Simple working drawing of trade related exercises using limits, fits, tolerance machining symbols e.t.c. e.g. simple fittings, ground stepped shafts and blocks e.t.c.
6. Assembly and detail drawing of trade related machine tools e.g. clapper box, tail stock, bench vice, simple drill jig etc.
7. Advance blue print reading relating to missing, limit size, fits, tolerance, machine symbols, reading out of detailed part drawing from an assembly and such other related problems from assembly drawing for operational analysis.
8. Solution of NCVT Test papers.
9. Revision.

**Social Studies:-** The syllabus for the social studies subject has been approved and common for all trades.